New Opportunities

- **2018 National Defense Authorization Act & 2018 Omnibus Appropriations**
  - Statistically-based PFAS biomonitoring exposure assessments (EAs) at no less than 8 current or former DOD sites (short term – completed within two years)
    - 10 million dollars for FY2018
    - EAs will include measurement of PFAS in serum and urine, as well as limited environmental (dust and tap water) sampling
  - Multi-site PFAS health study (long term – completed over next 5-7 years)
    - 10 million dollars anticipated for FY2019 for this effort, with possibility of additional funds in subsequent years
    - Study design will be informed by data from PFAS EAs

Multi-Site PFAS Health Study

- **ATSDR published feasibility assessment of possible future drinking water epidemiological studies at Pease, NH in November 2017**
  - Pease International Tradeport is former Air Force base
    - In 2014, one of three wells that serve Pease showed elevated levels of PFOS
    - Level above provisional health advisory set by EPA
    - NH DHHS conducted human biomonitoring program (over 1,500 participants)
  - ATSDR reviewed epidemiological studies that evaluated health effects of PFAS exposures
  - Based on literature review and sample size calculations, report concluded that cross-sectional epidemiological studies of children and adults at only one site (e.g., Pease)
    - Feasible for some health endpoints (e.g., lipids, kidney function)
    - Insufficient sample size for other health endpoints (e.g., thyroid, liver and immune function, autoimmune diseases)
  - Highlighted need for multi-site study

Multi-Site PFAS Health Study (cont.)

- **Study communities impacted by PFAS-contaminated public drinking water supply wells and/or private wells**
- **Cross-sectional study at multiple locations with separate evaluations of children (ages 4–17) and adults (ages ≥18)**
  - Case-control study not feasible; difficulties in enumerating cases
  - Cohort, follow up design aspects considered; funding uncertain
- **Site considerations**
  - Documented past or present PFAS drinking water concentrations at the tap,
  - The magnitude of past or present PFAS concentrations at the tap,
  - Size of population exposed,
  - Amount of information available on the contaminated drinking water system or private wells, and
  - If biomonitoring for PFAS has previously occurred at the site.

Multi-Site PFAS Health Study (cont.)

- **Expected sample size: 8,000 total participants**
  - 2,000 children
  - 6,000 adults
  - Based on review of scientific literature to study health outcomes of interest
- **Categorized participants based on measured or modeled serum concentration levels of PFAS compounds**
  - Referent or low, medium, high

Multi-Site PFAS Health Study (cont.)

Health Outcomes to be Studied						
Outcome	**Children**	**Adults**		**Outcome**	**Children**	**Adults**
Lipids	X	X		Neurobehavioral	X	
Cardiovascular	X	X		Osteoarthritis/ Osteoporosis		X
Kidney function/ Disease	X	X		Endometriosis		X
Liver function/Disease	X	X		Immune function	X	X
Thyroid	X	X		Vaccine response	X	
Sex hormones/ maturation	X			Autoimmune disease		X

Multi-Site PFAS Health Study (cont.)

- **Biomarkers to be studied**
  - Total cholesterol, low density lipoprotein, high density lipoprotein, total triglycerides
  - Uric acid, creatinine
  - Thyroxine (T4), T3, thyroid stimulating hormone (TSH)
  - Glucose, insulin, glycosylated hemoglobin (HbA1c), auto-antibodies (GAD-65 and IA-2), C-peptide, pro-insulin
  - Alanine transaminase (ALT), γ-glutamyltransferase (GGT), direct bilirubin, and cytokeratin-18 (CK-18)
  - Immunoglobulin G (IgG), IgA, IgE and IgM; (C reactive protein, and antinuclear antibodies (ANA) – adults; antibodies to measles, mumps, rubella, tetanus, and diphtheria – children)
  - Testosterone, estradiol, sex hormone-binding globulin (SHBG), follicle stimulating hormone, insulin-like growth factor
  - Cytokines and adipokines (e.g., IL-1β, IL-6, IL-8, MCP-1, TNFα, leptin, adiponectin, resistin, PAI-1)

Multi-Site PFAS Health Study (cont.)

- **Questionnaire data will collect information on**
  - Demographics
  - Water consumption and residential history
  - Medical history and family history of disease
  - Occupational history
  - Reproductive history in women
- **Neurobehavioral testing in children will include**
  - Measures of intelligence, hyperactivity, inattention, emotional conduct, peer relationship, and executive function.

Multi-Site PFAS Health Study (cont.)

- **Historical reconstruction of serum PFAS concentrations by estimating half-lives and elimination rates to inform physiologically based pharmacokinetic (PBPK) modeling**
  - Historical serum PFAS reconstruction based on water contamination data will enable evaluation of exposure lags and vulnerable periods as well as statistical analyses that can control for reverse causations